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FOREWORD

Research on biodiversity has been the cornerstone of our University's R & D endeavours. Biological diversity or biodiversity is the phrase to describe the vast range of life and the natural phenomena that occurs. This natural process and influences of humans of late shaped biodiversity which takes billion of years to evolve. Furthermore, it creates the network of life of which we belong to and upon which our lives so fully depend.

In this age of modernization, greater emphasis is placed on the conservation of biodiversity. It is our belief that the knowledge we have in the natural environment will spur us in creating a sustainable world that we live in. It is in our self-interest that we should protect biodiversity as its loss will endanger the food we consume, the sources of medicine, wood and energy and the potential for recreational and tourism activities.

It is vital that we place great emphasis in maintaining a well functioning ecosystem to preserve the continuous supply of ecological chain that would be enormously costly or even impossible to replace. As governments of the world are attempting to prevent the destruction of our natural environment, we as researchers, have a role to play in supporting these efforts by highlighting the importance and the functions of the ecosystem through our research efforts.

The research projects presented in this issue of Research Update underline the importance of biodiversity and environmental management for the betterment of our lives and to further enhance our understanding and expand our knowledge on the topics. It is my sincere hope that the research presented in this issue will encourage intellectual discussions and which will be translated into sustaining our biodiversity.

Prof Dr Peter Songan
Deputy Vice Chancellor (Research & Innovation)
Universiti Malaysia Sarawak

REDISCOVERY OF ONE OF THE WORLD'S TOP 10 MOST WANTED 'LOST FROGS', *ANSONIA LATIDISCA*, THE BORNEAN RAINBOW TOAD, ON GUNUNG PENRISSEN, WESTERN SARAWAK, BORNEO

Researchers: *Pui Yong Min, Ong Jia Jet and Indraneil Das*
Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak

Ansonia latidisca

Ansonia latidisca is an endangered species of tropical bufonid, currently known from two locations in the north-western corner of Borneo. Prior to our discovery, this species was known from only three individuals. The holotype, an adult male, was collected by Johann Hallier from the summit of Gunung Damus (Kalimantan, Indonesia), the paratype, a female, taken by Robert Shelford from Gunung Penrissen (Sarawak, Malaysia), in addition to that, a third specimen from the latter locality, collected by Eric Mjöberg. Listed as one of the 'World's Top 10 Most Wanted Lost Frogs' by the IUCN/SSC Global Amphibian Specialist Group and Conservation International, *A. latidisca* has not been sighted since the late 1920s. The species is listed as Endangered in Stuart et al. (2008) "in view of its extent of occurrence of less than 5,000 km^2 and area of occupancy of less than 500 km^2, with all individuals in fewer than five locations, and a continuing decline in the extent and quality of its habitat".

The 1,329 m Gunung Penrissen dominates western Sarawak, and forms the boundary between Malaysia's Sarawak State and Indonesia's Kalimantan Barat Province. Penrissen lies outside the protected area system of Sarawak, but is listed among the Important Bird Areas of the world by BirdLife International. The area has a long history of agriculture, especially rice, although rubber and pepper are also grown in all except the steepest terrain. Major development projects commenced in the Gunung Penrissen area in the last decade, with the view of promoting ecotourism and golf-tourism. We have located three individuals of *A. latidisca* on three different mature trees (ca. 2 m above ground) near forest trails. Prior to this, no photograph of live *A. latidisca* was available. One male found shows a distinctive vocal sac and developed testes. A female in our sample carries unripe ova, suggestive of reproduction later in the year. Our sample agrees with the original description in showing large body size (in the female), exposed tympanum, dilated finger tips, elongate limbs and lack of tarsal fold. We consequently announce the rediscovery of *A. latidisca* after its last collection in 1924.

MAN MEETS FROG: PERCEPTIONS, USE AND CONSERVATION OF AMPHIBIANS BY INDIGENOUS PEOPLE

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The European fire salamander (*Salamandra salamandra*), familiar in European folklore through its association with fire, and a symbol of sulphur for alchemists

Man, much like frogs, and water, are inextricably linked. The association, thus, between early human consciousness and these largely aquatic organisms is substantial and widespread in many cultures. This chapter explores both the antiquity of the man - amphibian relationship worldwide, synthesizing data from prehistoric and ancient historic textual sources, to more recent attitudes to amphibians. The sources of information thus have been data from zooarchaeological, material or cultural artifacts, folklore and indigenous beliefs, ancient (including religious) texts, rhymes, taboo, uses in societies for social control, pharmacological, culinary and agricultural researches, representations in advertisement and postage stamps, toys, models and other products, and for food and medicine by both Western and indigenous (here meaning non-Western) societies around the world. There appears to be a tendency by practitioners of modern science to dismiss nativism as absurd and illogical, and the use of animal-derived drugs as superstition. Thus, some long-known local knowledge has been reported by science in recent times, from the discovery of species to their potential use by man, especially in traditional Chinese medicine.

The role of amphibians in controlling insects has been known in China since ancient times, and a late Sung Dynasty edict (*ca.* 1250 AD) prohibited the capture or killing of frogs. Local restrictions may also apply to harvested species, presumably to control exploitation: in China, *Nanorana boulengeri* males may be captured but collection of females is not permitted. Local restrictions on the harvest of frogs in Laos, in response to noticeable decline in populations of *Hoplobatrachus rugulosus* is on record. In at least 50 villages in Khon District, Champasak Province, village regulations ban harvest during spawning time, including tadpole collection and a ban on other activities, such as the use of spotlights along the banks of the Mekong during the dry season, use of baited hooks in rice paddies, bamboo frog-trap lines, the use of metamorphs as fish bait and the construction of deep, steep-sided pits to entrap frogs in rice paddies. In Nepal, the usage of frogs for medicine is widespread. Local taboos, however, prevent their capture on all days of the week except Saturdays and Tuesdays. Bushmen of South Africa do not kill frogs, believing that such acts would stop rainfall, once again showing the association with water.

Apart from the perceived ecological functions, wild species may be respected for their traditional, cultural and spiritual roles, which may be the basis of local conservation programmes. The Lepchas of Sikkim prohibit hunting or collecting of rare plants and animals, which are regarded sacred, and also recognize biotically unique microclimatic zones. Frog worship itself has been reported from many eastern cultures, and there as well as elsewhere, the association of much of human beliefs, myths and representation in art appear to stem from the association of the humble frog with rainfall and fertility, and with its role as a predator of crop pests, and hence by extension, with the prosperity of early societies.

DISTRIBUTION OF SMALL CETACEANS IN THE NEARSHORE WATERS OF SARAWAK, EAST MALAYSIA

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An Irrawaddy dolphin near a fishing boat at Santubong Bay

Between June 2008 and September 2009, 56 days of small boat surveys were conducted off the coast of Sarawak, Malaysia with the aim of recording cetacean distribution. These surveys, which focused on the Miri, Bintulu-Similajau and Kuching regions, comprised 173 hours of survey effort and covered 2,851 km of pre-determined systematic tracks. Surveys were clustered into three sets of seasonal snapshots: June-July, September-October and March-April. A total of 115 cetacean sightings were made, of which 65 were on-effort and used in analyses of cetacean encounter rates in relation to habitat characteristics. Species observed included (in order of frequency) Irrawaddy dolphins (*Orcaella brevirostris*), finless porpoises (*Neophocaena phocaenoides*), Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) and Indo-Pacific humpback dolphins (*Sousa chinensis*).

One hundred and ten of 115 sightings were made in less than 10 m water depth, highlighting the importance of nearshore coastal habitats for these species. Despite an apparent overlap in habitat, Irrawaddy dolphins showed a statistically significant affiliation with areas of shallower depth and closer proximity to shore and river mouths than finless porpoises or bottlenose dolphins. This preference for nearshore areas renders the species vulnerable to threats such as fisheries by-catch and habitat degradation from coastal development. Irrawaddy dolphins were more frequently encountered in Kuching, while the highest encounter rate for finless porpoises was in the Bintulu-Similajau region. Depictions of encounter rates in these regions in relation to survey effort in 2 × 2 km grid-cells give an indication of the preferred habitats of Irrawaddy dolphins, and show that the highest encounter rates in both Kuching and Similajau occurred in areas that are destined for major coastal developments. The information presented here should help researchers and managers design effective future research and conservation strategies.

AVIFAUNA OF MOUNT SINGAI

Researchers: *Andrew Alek Tuen[1], Luisa Duya[2], Charlie J. Laman[2] and Mustafa Abdul Rahman[2]*
[1] Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak
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A Scops-owl (*Otus sp.*) that was caught at the middle elevation of Mount Singai

Avifauna surveys were conducted in September and December 2010 at the lower and middle elevations of Mount Singai, Sarawak, respectively, with the aim to record the species that occur there. The survey was conducted using 30 mist nets set at lower and middle elevations and by observation along the trail from the foot of the mountain to its summit. A total of 110 individuals representing 26 species of birds were netted. Little Spiderhunter was the most abundant species with 22 individuals, followed by Red-tailed Tailorbird and Rufous-backed Kingfisher, with 10 individuals each. Seventeen species were netted at lower and middle elevation only while eight species were netted at both lower and middle elevations. There was a pronounced effect of disturbance on birds caught at the lower elevation, with significantly less species (8 vs 13) and individuals (15 vs 22) caught in nets set along the heavily-used trail to the church complex compared to net set along the less-used Tirasag trail. Based on observation method, 74 species were recorded along the trail up to the church complex, 38 species were recorded at the church complex and old village area while only eight species were recorded along the trail to the summit. The greater diversity and abundance of birds along the trail to the church complex is suitable for nature-based tourism.

SMALL MAMMALS OF MOUNT SINGAI

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Western Tarsier (*Tarsius bancanus*), one of five individuals caught at Tirasag Trail (lower elevation of Mount Singai)

Small mammal surveys were conducted in September and December 2010 at the lower and middle elevations of Mount Singai, respectively with the aim to record the species that occur there. The survey was conducted by trapping using 30 mist nets and eight harp traps for bats, while 160 cage traps and 40 Sherman traps were used for rodents and treeshrews. Eleven species of bat, eight species of rodent, four species of treeshrew and one species of primate (Western Tarsier, *Tarsius bancanus*) were recorded. Significantly more species (22 vs. 6) and individuals (84 vs. 20) were recorded at the lower elevation compared to the middle elevation. The most abundant small mammal was the Short-nosed Fruit Bat (*Cynopterus brachyotis*), with 33 individuals. The five tarsiers, an insectivorous primate that is endemic to Borneo and totally protected by law in Sarawak, were all caught along the less-used Tirasag trail.

DISTRIBUTION OF FRUIT TREES AT DIFFERENT ELEVATIONS AT MOUNT SINGAI, BAU, SARAWAK, MALAYSIA

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[2] University of Waikato, New Zealand

Louisa McLellan next to a huge durian (*Durio zibethinus*) tree at Mount Singai

Singai Bidayuhs (BiSingai) once settled on Mount Singai, Bau district, Sarawak in eight villages about 230 meters up the mountain. Since their farms were located downhill, they had to commute between their farms and their mountain villages. Along the trails, there are fruit trees and other cash crops, resulting in a mosaic of forests types while areas further up the mountain have been left undisturbed. An inventory of the fruit trees was made along a trail that lead from the foothill to the top of Mount Singai, passing through the old mountain village, to determine if the occurrence of fruit trees followed a particular pattern or otherwise. Sampling was carried out in the 16 plots established earlier for the tree/timber survey, with each plot measuring 50 meters away from the trail and 10 meters wide. A total of 254 fruit trees from 12 different families were recorded. The fruit trees along the route to the farmland occurred most frequently nearer to the trail (within 10 meters) than further away from the trail. In general, the distribution of fruit trees decreases with increasing elevation and becomes rare at elevations between 425–557 m (plots 13–16), where only two fruit trees were found. The majority of the fruit trees surveyed were found at the site of an abandoned village and at the foothill. In terms of distribution, the Meliaceae family with 98 individuals is the dominant family while the families Anacardiaceae, Burseraceae and Flacourticeae are the least, with only one individual each. This study showed that the cultivation habits of the BiSingai affects the distribution of fruit trees on Mount Singai and that the number of fruit trees decreases with distance from trail.

REVISITING WALLACE'S HAUNT: COALESCENT SIMULATIONS AND COMPARATIVE NICHE MODELING REVEAL HISTORICAL MECHANISMS THAT PROMOTED AVIAN POPULATION DIVERGENCE IN THE MALAY ARCHIPELAGO

Researchers: *Lim Haw Chuan[1], Mustafa Abdul Rahman[2], Susan Lim[3], Robert Moyle[4] and Frederick Sheldon[1]*
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Bar-bellied Cuckoo Shrike (*Coracina striata*). This species is a widespread resident of lowlands, especially peatswamp forests

Sundaland, a biogeographic region of Southeast Asia, is a major biodiversity hotspot. However, little is known about the relative importance of Pleistocene habitat barriers and rivers in structuring populations and promoting diversification here. We sampled 16 lowland rainforest bird species primarily from peninsular Malaysia and Borneo to test the long-standing hypothesis that animal species on different Sundaic landmasses intermixed extensively when lower sea-levels during the Last Glacial Maximum (LGM) exposed land-bridges. This hypothesis was rejected in all but five species through coalescent simulations. Furthermore, we detected a range of phylogeographic patterns; Bornean populations are often genetically distinct from each other, despite their current habitat connectivity. Environmental niche modeling showed that the presence of unsuitable habitats between western and eastern Sundaland during the LGM coincided with deeper interpopulation genetic divergences. The location of this habitat barrier had been hypothesized previously based on other evidence. Paleo-riverine barriers are unlikely to have produced such a pattern, but we cannot rule out that they acted with habitat changes to impede population exchanges across the Sunda shelf. The distinctiveness of northeastern Borneo populations may be underlied by a combination of factors, such as, rivers, LGM expansion of montane forests and other aspects of regional physiography.

COMPARATIVE TEMPORAL DISCOLOURATION OF MOUNTAIN BLACKEYE (*CHLOROCHARIS EMILIAE*) MUSEUM DRY SPECIMEN IN SARAWAK

Researchers: *Mohd Fizl Sidq Ramji and Mustafa Abdul Rahman*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

Mountain blackeye (*Chlorocharis emiliae*)

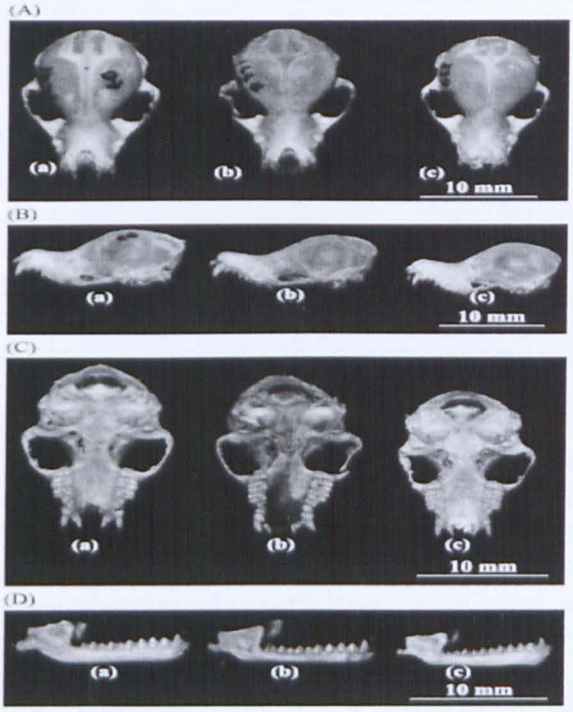
Church Camp on Mount Murud (2,100 m above sea level), which was used as base camp for Mount Murud expedition to capture the mountain blackeye

The mountain blackeye (*Chlorocharis emiliae*) is an excellent model species to illustrate evolution and speciation. Generally, the mountain blackeye is allocated to the family of Zosteropidae (the white eyes). The current taxonomic classification recognized four subspecies of mountain blackeye- *C. e. emiliae* on Mount Kinabalu, *C. e. trinitae* on Mount Trus Madi, *C. e. moultoni* on Mount Murud, Mount Mulu, Mount Poi and Tama Abo Range, and *C. e. fusciceps* on Mount Maga.

The definitive feature of mountain blackeye can be characterized by a conspicuous black orbital ring edged with light yellowish-green on the supercilium and jugulum of the head. These tit-like birds varied in terms of plumage colouration of the underparts from a range of olive-greens and yellows. Although the plumage complexities were apparent in each subspecies, they were documented as having distinctive plumage features by subjective interpretations of greenness, yellowness and relative darkness. Mountain blackeyes were also noted to have monomorphic colouration on both sexes. The plumage colour of *C. e. emiliae* skins taken by early Sarawak Museum collectors was reviewed and speculated that colour degrading was evident on earlier specimens prior to the collection dates. Holotype specimens displayed distinguished green crown compared to both recent specimens. Plumage colour studies using museum skins was one of the ways to understand species evolution and plumage polymorphism. The invaluable scientific information on a single historic specimen should be well-presented in the most regarded form of quality skin. However, aging plumage feathers are hypothetically susceptible to colour fading therefore doubting the relevant of using old specimens for plumage colour assessment. We examined the colour changes in 36 museum specimens by conducting series of Munsell colour scoring by comparing recent and old skins of mountain blackeye at Universiti Malaysia Sarawak (UNIMAS) and Sarawak Museum (SM). The year-gap of both sets (UNIMAS and SM) ranged from 52 to 75 years. Eight plumage characters included in this study were crown, supercilium, auricular, mantle, rump, breast, belly and vent. The results revealed that the head (crown and auricular) and underparts (breast and vent) tend to fade extensively overtime compared to the upperparts. Therefore, the results of this study showed that aging plumage feathers are susceptible to colour fading.

A MORPHOLOGICAL ANALYSIS OF MALAYSIAN *KERIVOULA* (CHIROPTERA, VESPERTILIONIDAE)

Researchers: *Noor Haliza Hasan and Mohd Tajuddin Abdullah*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak



Skulls comparisons of *K. papillosa* type L, *K. papillosa* type S and *K. lenis*, accordingly (a, b and c). (A) View from the upper side of skulls, (B) View from the rear side of skulls, (C) Palatal view of skull and (D) Mandible view of skull

Recent identification of new species within the genus *Kerivoula* from the Southeast Asian region has indicated that this genus is understudied and currently underestimated in terms of its species diversity. Thus, morphological studies on the species included in the genus was carried out to record and analyse the morphological characters of available specimens of Malaysian *Kerivoula* from the Museum of Zoology, Universiti Malaysia Sarawak. Thirty-one external, skull and dental characters were taken and analysed using the multivariate analysis, discriminant function analysis. As a result, six groupings of *Kerivoula* was identified, namely, *K. intermedia, K. hardwickii, K. pellucida, K. lenis* and *K. papillosa* which were divided into two distinctive groupings of *K. papillosa* type large (*K. papillosa* type L, hereafter) and *K. papillosa* type small (*K. papillosa* type S, hereafter). Variable dentary length was identified as the best predictor to characterize each group of *Kerivoula*. The separation of the *K. papillosa* specimens into two separate morphotypes were characterised by their different sizes whereby the former group was larger in size compared to the latter. It is suggested that each represents an independent species even though both morphotypes occur sympatrically. The homogenising effect of the previous environmental events might have been the primary factor of the sympatric occurrence of both morphotypes. Nevertheless, further study regarding ecology, morphology and genetics should be carried out to provide a better insight regarding the cryptic population of *K. papillosa* in Borneo and Malaysia. There is a new species of bat to be described in this species complex.

REPRODUCTIVE CYCLE OF THE RAZOR CLAM *SOLEN REGULARIS* DUNKER, 1862 IN THE WESTERN PART OF SARAWAK, MALAYSIA, BASED ON GONADAL CONDITION INDEX

Researchers: *Aileen May Ridis Rinyod and Siti Akmar Khadijah Ab Rahim*
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Razor clam, *Solen regularis*

Razor clam or 'ambal' is a highly-priced bivalve collected as food source from several intertidal areas located in western Sarawak, which currently is an unregulated fishery. This study monitored the reproductive cycle of razor clam, *Solen regularis*, collected from the intertidal beaches of Asajaya Laut and Buntal using gonadal condition index (GCI). Sampling was performed at a two-week interval or monthly for two years from March 2007 to February 2009. A total of 30 specimens were dissected per sampling. The male gonads appeared beige in colour, while female gonads were whitish. Throughout the study, the mean GCI ranged from 0.000 (± 0.000) to 0.247 (± 0.077) at Asajaya Laut and 0.000 (± 0.000) to 0.253 (± 0.079) at Buntal. Based on the mean GCI pattern, it is concluded that this razor clams has five stages of reproductive cycle as follows: i) gonadal development, ii) maturation, iii) spawning, iv) spent, and v) resting period. Spawning period for both sites was similar, from end of March-April to September and followed by a short spent stage from end of September-October to November and a resting period from end of October-November to January in the following year. The results obtained in this study could provide important knowledge in determining the spawning season which will benefit razor clam fishery for sustainable management and potential species for aquaculture in the future.

TREATMENT OF SHRIMP POND EFFLUENT USING SEDIMENTATION POND IN THE TROPICS

Researchers: *Lee Nyanti, George Anak Berundang and Ling Teck Yee*
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The site of the experiment at Lembaga Kemajuan Ikan Malaysia at Telaga Air, Sarawak

A shrimp aquaculture pond

A drained pond in the shrimp aquaculture farm

Aquaculture plays a major role in providing the needed protein to humans. However, there have been reports of negative impacts of shrimp farming which include environmental pollution. Therefore, shrimp pond effluent had to be retained for treatment. Treatment in tanks showed significant improvement in water quality, but in sedimentation ponds, it may not be the case. The objective of this study was to determine the water quality of effluent retained in sedimentation pond for a duration of 76 hours. Results show that water quality at 1/3 depth was better than 2/3 depth. There was an improvement in water quality with reductions of TSS, BOD5, COD, nitrate-N, nitrite-N, SRP and TP ranging from 25-52% except for DO and TAN. In addition, there was fluctuation of each parameter during the duration of study. It is important to monitor the water quality prior to the release of effluent so that it coincides with low nutrients and acceptable DO and partial release of the top 1/3 portion is recommended. There is a limit on the reduction achievable by sedimentation ponds likely due to processes occurring in the sediment. For higher reductions, other methods of effluent management and recovery of nutrients have to be considered.

BATS OF WIND CAVE NATURE RESERVE, SARAWAK, MALAYSIAN BORNEO

Researchers: *Mohd Ridwan Abd Rahman, Roberta Chaya Tawie Tingga, Noor Haliza Hasan, Mohd Isham Azhar and Mohd Tajuddin Abdullah*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

Hipposideros larvatus Horsfield 1823– Intermediate leaf-nose / horseshoe

Hipposideros ridleyi Robinson & Kloss, 1911– Ridley's leaf-nose / horseshoe bat

Hipposideros galeritus Cantor, 1846 – Cantor's leaf-nose / horseshoe bat

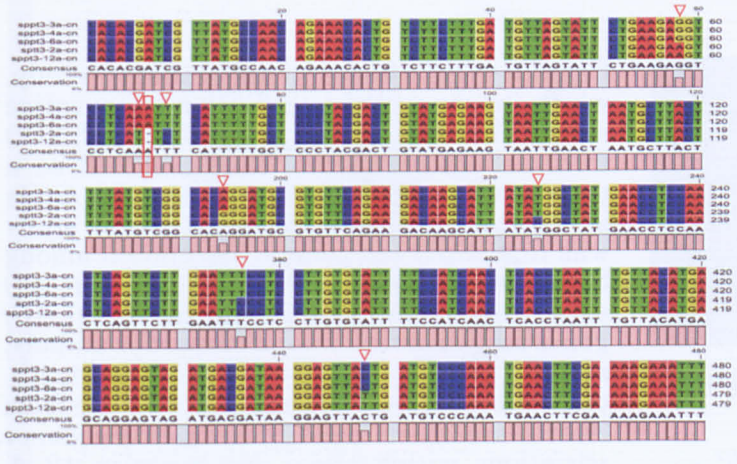
Tylonycteris robustula Thomas, 1915 – Greater bamboo bat

Tylonycteris pachypus Temminck, 1840 – Lesser bamboo bat

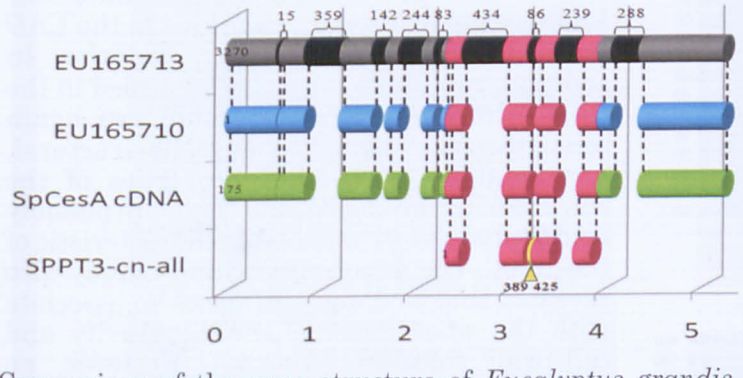
A survey of the chiropteran species at the Wind Cave Nature Reserve (WCNR) in the Bau limestone areas (BLA), Sarawak, was conducted between 10-20 January 2008 and 10-20 April 2009. A total of 297 and 367 (net 646) individuals, representing 14 and 11 (net 17) species from four families were captured in 2008 and 2009, respectively, from an effort of 143 each (net 286) sampling nights. This represents eight new recordings for the WCNR and approximately 85%, 45.9% and 17.7% of the total species recorded in the WCNR, BLA and Borneo, respectively. Over both years, the most commonly captured species was by far *Penthetor lucasi* followed by *Hipposideros cervinus*, which comprised of 63% and 22% of the total (2008 and 2009) captures, respectively. Four and eight species were recorded as the new locality records for Wind Cave (WC) and WCNR, respectively, with *Rhinolopus arcuatus*, *H. larvatus*, *H. coxi*, *H. ridleyi*, *H. galeritus*, *Kerivoula pellucida*, *Tylonycteris robustula* and *T. pachypus* being new records for WCNR. This documentation is of importance for forest conservation and management in the future.

SEQUENCE VARIATION IN THE *CELLULOSE SYNTHASE (SPCESA1)* GENE FROM *SHOREA PARVIFOLIA* SSP. *PARVIFOLIA* MOTHER TREES

Researchers: *Ho Wei Seng, Pang Shek Ling, Pauline Lau and Ismail Jusoh*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak



Seven SNPs were detected at nucleotides 58, 66, 69, 194, 224, 376, and 448 (red triangle) and one INDEL detected at nucleotide 67 (red box)

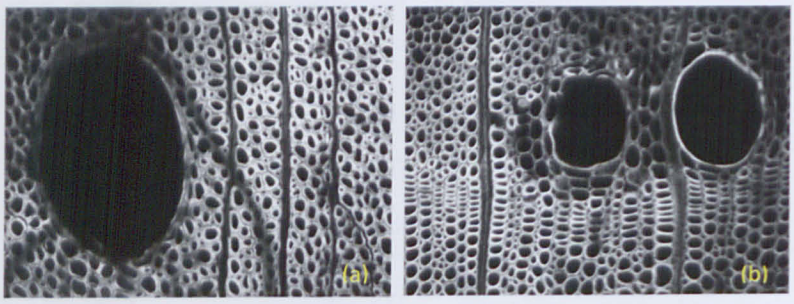


Comparison of the gene structure of *Eucalyptus grandis CesA3* genomic DNA (Genbank accession no.: EU165713; 8771 nt), *E. grandis CesA3* mRNA (Genbank accession no.: EU165710; 3331 nt), full-length *SpCesA1* cDNA (Genbank accession no.: GQ338420; 3308 nt), and consensus sequence of all the five partial *SpCesA1* genomic DNAs. Figures before each sequence denote the start nucleotide in the alignment. Coloured cylinders represent exons and black cylinders represent introns with number of bases indicated above them. The intron portion as predicted from the partial *SpCesA1* genomic DNA is shown in solid yellow. Dotted lines connecting different genes indicate conserved intron-exon junctions.1 unit axis: 1kb

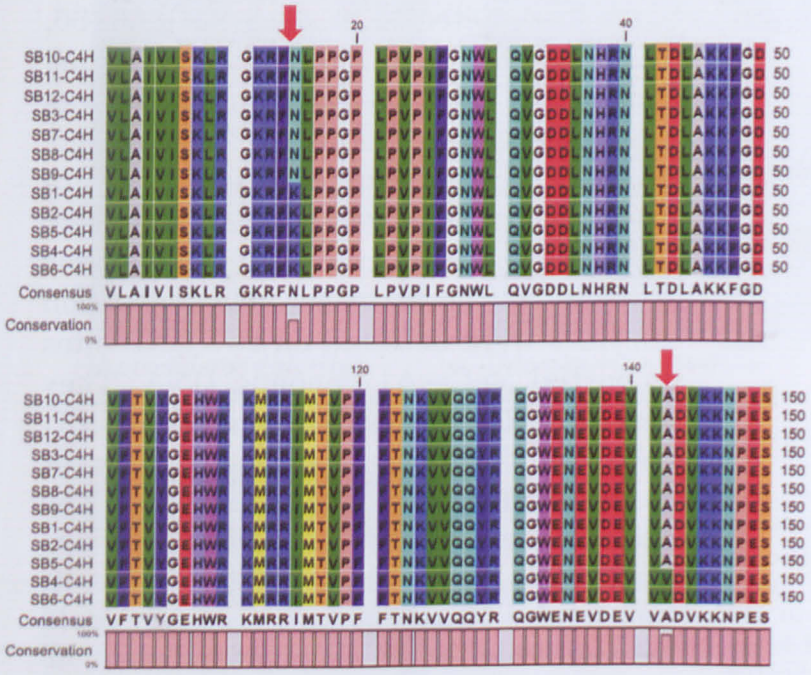
Cellulose synthase (CesA) is the key enzyme involved in the regulation of cellulose biosynthesis pathway. It is heritable and important in determining the variability of the wood. Hence, it provides a greater impact on the design of future genetic improvement strategies in the production of wood with better quality. We examined the molecular diversity of partial SpCesA1 genomic DNAs (802 bp) generated through PCR amplification followed by sequencing from five selected *Shorea parvifolia* ssp. trees. The consensus sequences were aligned to detect the presence of single nucleotide polymorphisms (SNPs). Seven SNPs were detected at nucleotide 58, 66, 69, 194, 224, 376 and 448. Interestingly, one single base pair InDel polymorphism was also detected at nucleotide 67. On average, one SNP at every 109 bp of sequence data was detected. However, this result is made upon the study of partial SpCesA1 genomic DNA of 802 bp. Two possible restriction enzymes were detected on two SNP sites of partial SpCesA1 genomic DNA. They are EarI (5'-GAAGAG-3') and EcoRI (5'-GAATTC-3'), which recognize and later cut at nucleotides 48 and 370, respectively. The exclusiveness of the restriction enzymes EarI and EcoRI obtained for SNPs at nucleotides 58 and 376, respectively could be useful for the development of cleaved-amplified polymorphic sequence (CAPS) markers, which could also be used to understand the molecular diversity of the CesA genes in tropical tree genomes.

GENE-ASSOCIATED SINGLE NUCLEOTIDE POLYMORPHISM (SNP) IN *CINNAMATE 4-HYDROXYLASE (C4H)* AND *CINNAMYL ALCOHOL DEHYDROGENASE (CAD)* GENES FROM *ACACIA MANGIUM* SUPERBULK TREES

Researchers: *Tchin Boon Ling, Ho Wei Seng, Pang Shek Ling and Ismail Jusoh*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak



Transverse section of *A. mangium* Superbulk. Cell wall thickness was measured from the transverse section of *A. mangium* Superbulk wood by using confocal laser scanning microscope (40X objective). From the figures, the cell wall of SB1 sample (a) was thicker than the cell wall of SB6 sample (b)



Synonymous and nonsynonymous mutations in partial C4H amino acid sequence. The arrow indicates the position and identity of two nonsynonymous SNPs in predicted partial C4H amino acid sequences

Candidate-gene-based association study, which involves the identification of causative single nucleotide polymorphisms (SNPs) for excellent traits, has been proposed as a promising approach to dissect complex traits in forest trees. Hence, the goal of this study was to identify the genetic association among SNPs from *cinnamate 4-hydroxylase (C4H)* and *cinnamyl alcohol dehydrogenase (CAD)* genes and an array of wood properties namely, specific gravity, wood density, fiber-length, cell wall thickness and microfibril angle from *Acacia mangium* Superbulk trees. Sequence variations within these two genes in 12 *A. mangium* Superbulk trees were examined and wood properties were measured. The data obtained was tested using general linear model (GLM) within TASSEL software. Two SNPs were identified in the exon of *C4H*, of which all the SNPs caused nonsynonymous mutations whereas five SNPs were identified in the *CAD* exons along with one deletion mutation. In addition, two SNPs were also identified in the *CAD* introns. Variation in these two lignin biosynthesis genes might change the structural, functional or biochemical properties of the enzyme being produced, and therefore possibly lead to changes in phenotypic characteristic of the trees. The genetic association study also revealed that SNPs in *CAD* gene do associate with the wood density, specific gravity and cell wall thickness ($p<0.05$). However, no significant results were obtained for SNPs in *C4H* gene with wood properties studied. Thickening of cell wall is affected by the arrangement of biopolymer aggregates which comprise of cellulose, hemicellulose and lignin. Results indicated that SNP in *CAD* gene might alter the lignin biosynthesis and thus lead to changes in phenotypic characteristics of the trees. Overall, the study has demonstrated that SNP is very useful in association genetic study to identify quantitative trait nucleotide (QTN), which then leads to gene-assisted selection (GAS) in the tree breeding programme.

ECTOPARASITES OF SMALL MAMMALS IN FOUR LOCALITIES OF WILDLIFE RESERVES IN PENINSULAR MALAYSIA

Researchers: *Madinah Adrus, Fatimah Abang, Mariana Ahamad and Mohd Tajuddin Abdullah*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

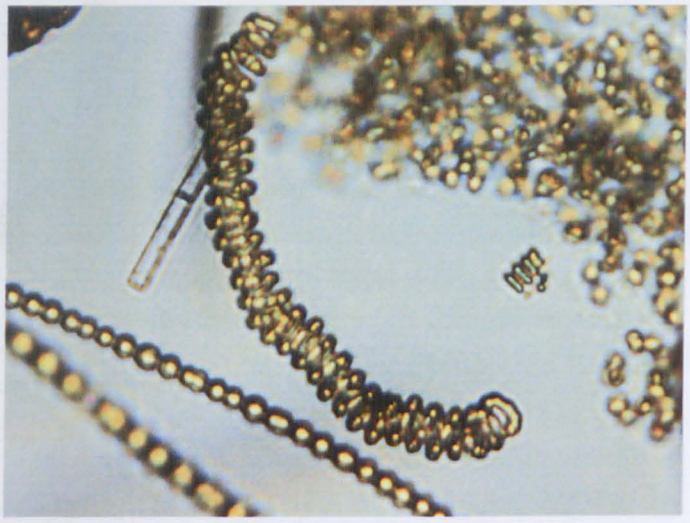
Hard tick (*Ixodes granulates*), a species of medical importance

Chigger mite (*Leptotrombidium deliense*), another species of medical importance

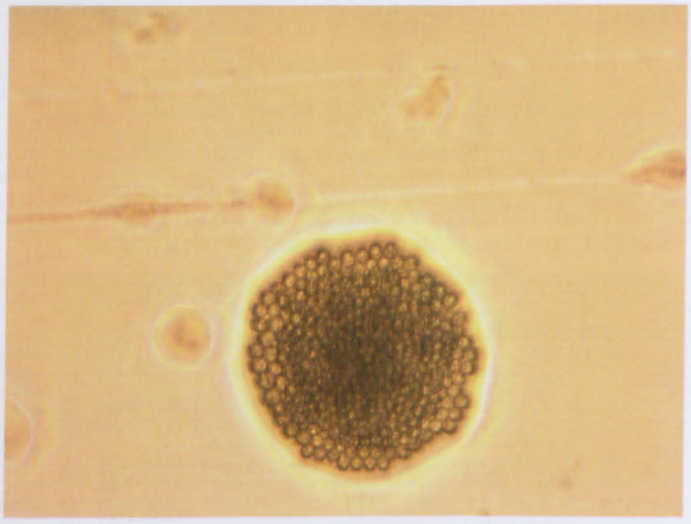
Field surveys of ectoparasites on rodents and scandents were conducted at four localities within wildlife reserves in Peninsular Malaysia, from October 2008 to November 2009. A total of 16 mammals, comprising five species, were caught and examined for ectoparasites. The hosts examined were *Maxomys rajah, Maxomys whiteheadi, Leopoldamys sabanus, Lariscus insignis* and *Tupaia glis*. Of these hosts, nine genera, consisting of fourteen species of ectoparasites were extracted. Three species of ticks (Ixodidae), seven species of mesostigmatid mites (Laelaptidae), three species of chiggers (Trombiculidae), and one species of listrophorid mites (Listrophoriidae) were identified. The infestation rate of ectoparasites observed ranged from 12.5% to 62.5%. Among the ectoparasites found, *Ixodes granulatus* and *Leptotrombidium deliense* are of known medical importance.

DIVERSITY AND SIMILARITY AMONG CYANOBACTERIA ASSEMBLAGES FROM SELECTED AQUATIC ECOSYSTEMS IN SARAWAK USING β–INDICES

Researchers: *Mohd Nasarudin Harith and Ruhana Hassan*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak



Anabaena and *spirulina*, the genera of cyanobacteria identified from an earth pond



Microcyctis, the cyanobacterial genera identified from an earth pond

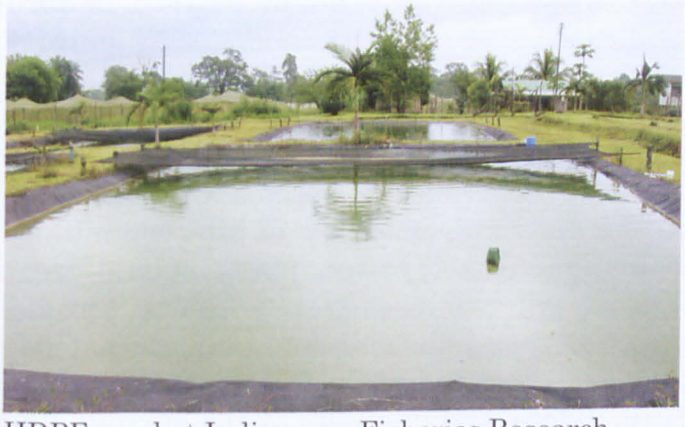
A study was carried out to evaluate the diversity and similarity of cyanobacterial populations in selected Sarawak aquatic ecosystems using β-indices. Eight stations including aquaculture ponds, cage cultures, waterfall and artificial lake located in Serian, Bau and Batang Ai areas were selected. A total of 43 species belonging to 30 genera of cyanobacteria were recorded. The most distributed pattern among all sampling stations belongs to the genera *Chroococcus, Lyngbya, Nostoc* and *Oscillatoria*. The highest β diversity values were found among non-contiguous stations. Besides, no identical or totally different cyanobacteria diversity values were obtained among those non-contiguous stations. The highest β diversity value (0.84) was found among stations with contrasting environmental characteristics. The wide range of β-diversity and similarity suggested that different locations and types of aquatic ecosystems may have variations in physico-chemical properties of the water that eventually lead to the different composition of cyanobacteria.

BLUE-GREEN ALGAE AND NUTRIENT CONCENTRATIONS IN TWO *TOR TAMBROIDES* AQUACULTURE PONDS DIFFERING IN CONSTRUCTION

Researchers: *Mohd Nasarudin Harith and Ruhana Hassan*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

Visible bloom observed at an earth pond

Sampling at High density polyethylene (HDPE) pond



HDPE pond at Indigenous Fisheries Research and Production Centre (IFRPC), Tarat, Serian

Two mahseer fish (*Tor tambroides*) aquaculture ponds located in Serian district, Sarawak were investigated for blue-green algae composition and nutrient dynamics in a six month period (January to June 2007). A total of 35 blue-green algae species belonging to 11 genera and four families were recorded. The genera *Chroococcus, Nostoc, Oscillatoria, Pleurocapsa* and *Synechocystis* were found in both ponds. Potential toxin producer genera, *Microcystis* and *Anabaena* formed a visible brown bloom on the surface of the earth pond. The highest blue-green algal cell density was recorded in June for the earth pond (1,009,000 cells ml^{-1}) and in January for the High density polyethylene (HDPE) pond (521,000 cells ml^{-1}). The highest chlorophyll concentration was documented in June for both ponds (10.2377 μgl^{-1} in HDPE pond and 172.1160 μgl^{-1} in the earth pond). Nutrient concentration, namely, soluble reactive phosphorus (SRP) (0.01-2.02 mgl^{-1} in HDPE pond, and 0.01-0.29 mgl^{-1} in earth pond), ammonia-nitrogen (0.01-0.90 mgl^{-1} in HDPE pond and 0.01-0.45 mgl^{-1} in earth pond) and nitrate (0.02-0.08 mgl^{-1} in HDPE pond and 0.01-0.05 mgl^{-1} in earth pond) were also recorded. This finding suggested that the earth pond is prone to experience algae bloom and at the same time, could support greater population of blue-green algae. Results also showed that SRP and nitrate are not the only factors that influence blue-green algae composition in aquaculture ponds, but rather a combination of other multiple environmental factors.

THE EFFECT OF SURROUNDING LANDSCAPE MATRIX ON MANGROVE BIRD COMMUNITY ASSEMBLY IN NORTH AUSTRALIA

Researchers: *Mohd-Azlan Jayasilan.[1] and Michael J. Lawes[2]*
[1]Faculty of Resource Science and Technology, Universiti Malaysia Sarawak
[2]Research Institute for the Environment and Livelihoods, Charles Darwin University, Australia

The lead author is investigating a mangrove robin nest in Charles Darwin National Park in Northern Australia

Little bronze cuckoo is a common species found in mangroves around Darwin

Red-headed honeyeater is one of the mangrove dependent species feeds on the nectar from the flowers of *Bruguiera parviflora*

Mangroves are highly threatened ecosystems, yet their community ecology is poorly understood. We examined the ecological determinants of bird community assemblage in floristically depauperate mangroves. Birds were surveyed using line transect methods. Large mangrove patches supported fewer species than smaller patches. Patches did not comprise nested species subsets and the bird species richness of several small patches combined was greater than a single large area. The number of mangrove dependent species in a patch was area-dependent suggesting these species may be resource limited, although there was no species density compensation. There was a clear effect of the surrounding habitat, with matrix species accounting for 45% of bird species in a patch. Patches surrounded by tropical savanna were relatively species-poor, while regardless of size, patches including monsoon rainforest were relatively species rich. Null model analysis of non-random assemblage structure (nestedness and species co-occurrence) revealed no deterministic structure to the overall mangrove species assemblage. These analyses described a random pattern of bird distribution, and with no evidence of density compensation, this suggests that competition is a weak structuring force of mangrove bird assemblages. The lack of nestedness and the random co-occurrence of species are consistent with the matrix-dependence of bird community composition. Conservation plans should treat mangrove patches as part of a habitat mosaic, and incorporate many smaller mangrove patches rather than just big ones. Consideration of the nature, extent and diversity of the surrounding matrices is vital in managing and conserving mangrove bird communities.

GENETIC CHARACTERIZATION OF TWO MAHSEER SPECIES (*TOR DOURONENSIS* AND *TOR TAMBROIDES*) USING MICROSATELLITE MARKERS FROM OTHER CYPRINIDS

Researchers: *Yuzine B. Esa[1], Siti Shapor Siraj[2], Khairul Adha A. Rahim[1], Siti Khalijah Daud[3], Ho Ghim Chong[3], Tan Soon Guan[4] and Muhammad Fadhil Syukri[2]*

[1]Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

[2] Faculty of Agriculture, Universiti Putra Malaysia

[3] Faculty of Science, Universiti Putra Malaysia

[4] Department of Molecular Biology, Universiti Putra Malaysia

Tor douronensis (Kelah, Semah or Blue Mahseer)

Common habitat of Mahseer

This study examined the genetic characteristics of twenty-six microsatellite primers developed from three cyprinid fishes (*Cyprinus carpio* Linnaeus, *Barbus barbus* Linnaeus and *Barbonymus gonionotus* Bleeker) in two indigenous mahseer species. *Tor douronensis* Valenciennes were collected from two locations in Sarawak (n=52), while *Tor tambroides* Bleeker were obtained from Peninsular Malaysia (n=56). A total of 10 and 12 primers were successfully amplified, producing four and five polymorphic loci in *T. douronensis* and *T. tambroides*, respectively. The number of alleles per locus ranging from 2 to 5 in *T. douronensis* and 2 to 7 in *T. tambroides*. A significant deviation from Hardy-Weinberg equilibrium (HWE) was observed at three loci (Barb37, Barb59 and Barb62) in one or more populations in *T. tambroides*, while two loci (Barb37 and Barb62) were deviated in *T. douronensis* population of Batang Ai. Population structure analysis showed low level of inter-population genetic differentiation in both mahseer. Overall, the identified microsatellite loci should be useful in analysing *T. douronensis* and *T. tambroides* natural populations.

NEW DISTRIBUTIONAL RECORD OF *HYPOCHROSIS CRYPTOPYRRHATA* WALKER, 1862 (GEOMETRIDAE: ENNOMINAE) FROM PENINSULAR MALAYSIA

Researchers: *Muhamad Ikhwan Idris and Fatimah Abang*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

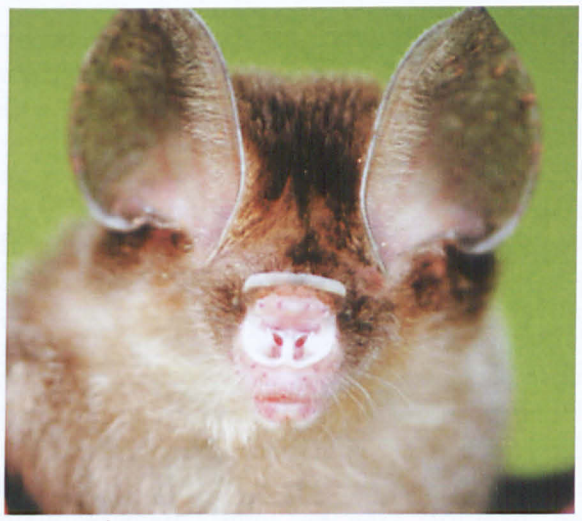
Hypochrosis cryptopyrrhata ß (16.48 mm)

A single male specimen of *Hypochrosis cryptopyrrhata* Walker, 1862 was sampled in one of the ground level light-traps in the Perlis State Park, Malaysia on 20 July 2009. The specimen had a forewing length (wing base to apex) that is measured 16.48 millimeter. The specimen is the first record for this species in Peninsular Malaysia. Prior to this, the species is geographically distributed in Borneo and Sumatra, thus comprising a new distribution record for this common lowland and lower montane forest species, although recently 11 individuals of the species were recorded from hill dipterocarp forest of Poring, Sabah, Malaysia.

Generally, this new record is a response to the low documentation of macromoth species distribution throughout the region of Malaysia-Thai border that is described as Kedawi. The monsoon climate of this region resembles that of southern Thailand rather than any other parts of Peninsular Malaysia. Possible reasons for the addition of new records are an extension of range of species not previously recorded in this area; and also species may have been overlooked by previous collectors because of their rarity in this region but the former needs a complete compilation and intensive long-term study on the macromoth distribution.

PHYLOGENETIC ANALYSIS OF THE MALAYSIAN *RHINOLOPUS* AND *HIPPOSIDEROS* INFERRED FROM PARTIAL MITOCHONDRIAL DNA CYTOCHROME *b* GENE SEQUENCES

Researchers: *Siti Nurlydia Sazali, Besar Ketol and Mohd Tajuddin Abdullah*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak



Hipposideros cineraceus Blyth, 1853 - Ashy Roundleaf bat

The phylogenetic relationships among 10 species of *Rhinolophus* and 10 species of *Hipposideros* from Borneo and Peninsular Malaysia were successfully inferred from the partial mitochondrial DNA (mtDNA) cytochrome (cyt) *b* sequences. Of the 413 nucleotide positions examined, there were 171 positions (41.4%), of which 164 positions (95.9%) were parsimoniously informative. The phylogenetic trees reconstruction using neighbour-joining (NJ), unweighted maximum parsimony (MP) and maximum likelihood (ML) methods suggest the monophyletic clustering of these families. The interspecific relationships within Rhinolophidae were completely resolved, while those within Hipposideridae were not fully resolved, as supported by the low bootstrap values. Overall, the phylogenetic analysis using partial mtDNA cyt *b* gene was useful to discriminate these complicated taxa and successfully revealed the misidentification of several specimens before, due to their similar morphologies.

NEW DISTRIBUTION RECORD OF ASHY ROUNDLEAF BAT *HIPPOSIDEROS CINERACEUS* BLYTH 1853 IN SARAWAK, MALAYSIAN BORNEO: CONSERVATION IMPLICATIONS

Researchers: *Siti Nurlydia Sazali, Faisal Ali Anwarali, Besar Ketol, Wahap Marni and Mohd Tajuddin Abdullah*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

Rhinolophus affinis

Rhinolophus trifoliatus

Hipposideros ridleyi

Hipposideros coxi

Hipposideros cervinus

Herein we report a new distribution record of Ashy Roundleaf bat (*Hipposideros cineraceus*) from Mount Murud, Sarawak. These specimens were initially assigned to *H. ater*, in the field using external attributes and measurements. As these specimens external measurements overlaps with other morphologically similar *bicolor* species group (e.g., *H. bicolor, H. cineraceus* and *H. dyacorum*), the recognition of these specimens remains uncertain. We employed morphometric hierarchical cluster analysis and molecular DNA sequencing technique to provide species level discrimination between other similar bicolor species group individuals. Results from the analyses suggest that specimens assigned as *H. ater* were misidentified, and comparisons with other related species description provide evidence for the recognition of *H. cineraceus*. Subsequently, this documents the first record of *H. cineraceus* distribution in Mount Murud, Sarawak. As the specimens studied here diverged genetically (5%) in cytochrome b gene from those in Peninsular Malaysia, this suggests that *H. cineraceus* individuals in Borneo or at least in Sarawak may represent a different evolutionary lineage. We propose the revision of *H. cineraceus* conservation status, especially for those in Borneo to be changed to endangered species status, given the scarcity of their distribution and genetic divergence. Further studies incorporating specimens from other populations from the Asian mainland and Borneo may provide insights in reevaluating the taxonomic status and their specific conservation status in this *H. cineraceus* complex.

COMPARATIVE DISTRIBUTION AND DIVERSITY OF BATS FROM SELECTED LOCALITIES IN SARAWAK

Researchers: *Jayaraj Vijaya Kumaran, Besar Ketol, Wahap Marni, Isa Sait, Mohamad Jalani Mortada, Faisal Ali Anwarali Khan, Fong Pooi Har, Leslie S. Hall and Mohd Tajuddin Abdullah*
Faculty of Resource Science and Technology, Universiti Malaysia Sarawak

Surveys on the chiropteran diversity were conducted at eight different localities in Sarawak to document the bat diversity, as well as to estimate the composition of bats in these areas. The major finding of bat surveys shows that montane areas have distinct chiropteran composition compared with those in lowland and logged areas. Disturbed habitats do pose a threat to the overall diversity of bats, with the generalist bats been more successful in colonising altered area than those with specialised habitat requirements. Sampling of bats targeted at different site and vegetation type from several protected areas in Sarawak have revealed the current record of bats in Sarawak and its diversity can be monitored for better management of biodiversity in this important region.

Aethalops alecto

Dyacopterus spadiceus

Murina rozendaali

Rhinolophus trifoliatus

STUDIES ON SCHISMATOGLOTTIDEAE (ARACEAE) OF BORNEO XVI: A NEW SPECIES AND A NEW INFORMAL TAXON (THE MULTINERVIA COMPLEX) OF *SCHISMATOGLOTTIS* FROM SARAWAK

Researchers: *Wong Sin Yeng[1] and Peter C. Boyce[2]*
[1]Faculty of Resource Science and Technology, Universiti Malaysia Sarawak
[2]School of Biological Sciences, Universiti Sains Malaysia

A. Plants in habitat

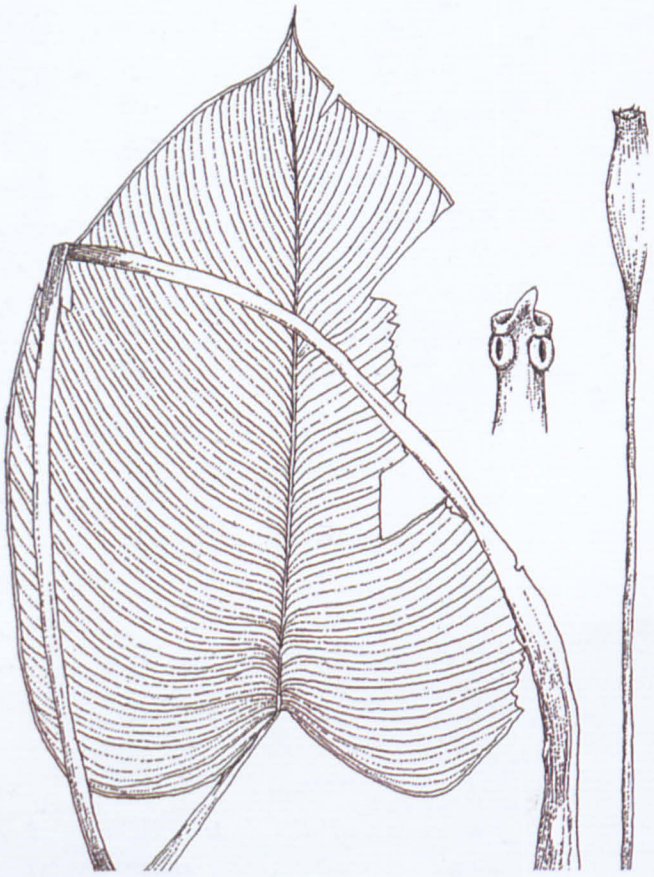
B. Adventitious plantlets on the tip of the leaf blade

C. Inflorescence just prior to anthesis
D. Inflorescence at onset of pistillate anthesis
E. Inflorescence at male anthesis
F. Spadix at staminate anthesis with the spathe artificially removed

Schismatoglottis hayi is described as a new species endemic to the forested limestone outcrops at Niah National Park, north east of Sarawak. It is morphologically most similar to *S. multinervia* M.Hotta, a species here redefined as being endemic to Mulu National Park, where it is an obligate of limestone. Together these two species are proposed as constituting a new informal taxon, the Multinervia Complex, defined by the combination of vegetative tissues aromatic (terpenoids) when crushed, a fully adnate petiolar sheath, petioles and major veins abaxially pubescent, spathe limb darkening internally rapidly at onset of anthesis and thence splitting longitudinally into wide recurving strips, an hourglass-shaped spadix, and large staminodes in 1-2 rows at the junction of the pistillate zone with the spathe. *Schismatoglottis hayi* is, by modification to the existing key, included into a key to Bornean *Schismatoglottis*. Both species are illustrated. Previous confusion between *S. hayi* and *S. puberulipes* Alderw is highlighted and clarified.

A NEW ENDEMIC SPECIES OF SCHISMATOGLOTTIS FROM THE PHILIPPINES

Researchers: *Wong Sin Yeng[1], Peter C. Boyce[2] and Josef Bogner[3]*
[1]Faculty of Resource Science and Technology, Universiti Malaysia Sarawak
[2]School of Biological Sciences, Universiti Sains Malaysia
[3]Gersthofen, Germany



Schismatoglottis ifugaoensis – a: whole leaf; b: postfloral inflorescence (upper part of spathe and spadix already shed); c: stamen. – All from the holotype *Bogner 1630* (M); drawing by Kerstin Schuster

Recent revisions of the Schismatoglottideae together with subsequent updates and additions have established an excellent working platform from which to undertake further research. Extensive fieldwork and re-examination of herbarium material by the authors has revealed that there remain many taxa that have yet to be formally recognised, and in addition that several named species are too broadly circumscribed, and on a critical inspection revealed to comprise several to rather many locally endemic species. Such an example, in the genus *Schismatoglottis* Zoll. & Moritzi, came to light during a tour of European herbaria. Critical examination of herbarium specimens in the Botanische Staatssammlung München (M) revealed that several sheets attributed to *S. bogneri* A. Hay represent in fact a similar but morphologically distinct, undescribed species, which is described in the present paper. A new species of the tribe Schismatoglottideae, *Schismatoglottis ifugaoensis* from the Philippines, is described and illustrated. It is characterised by cordate leaf blades, subsessile stigmas and excavated stamens with elongated, tonguelike connectives of the anthers. A revised key of the Philippine species of the genus *Schismatoglottis* is included.

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